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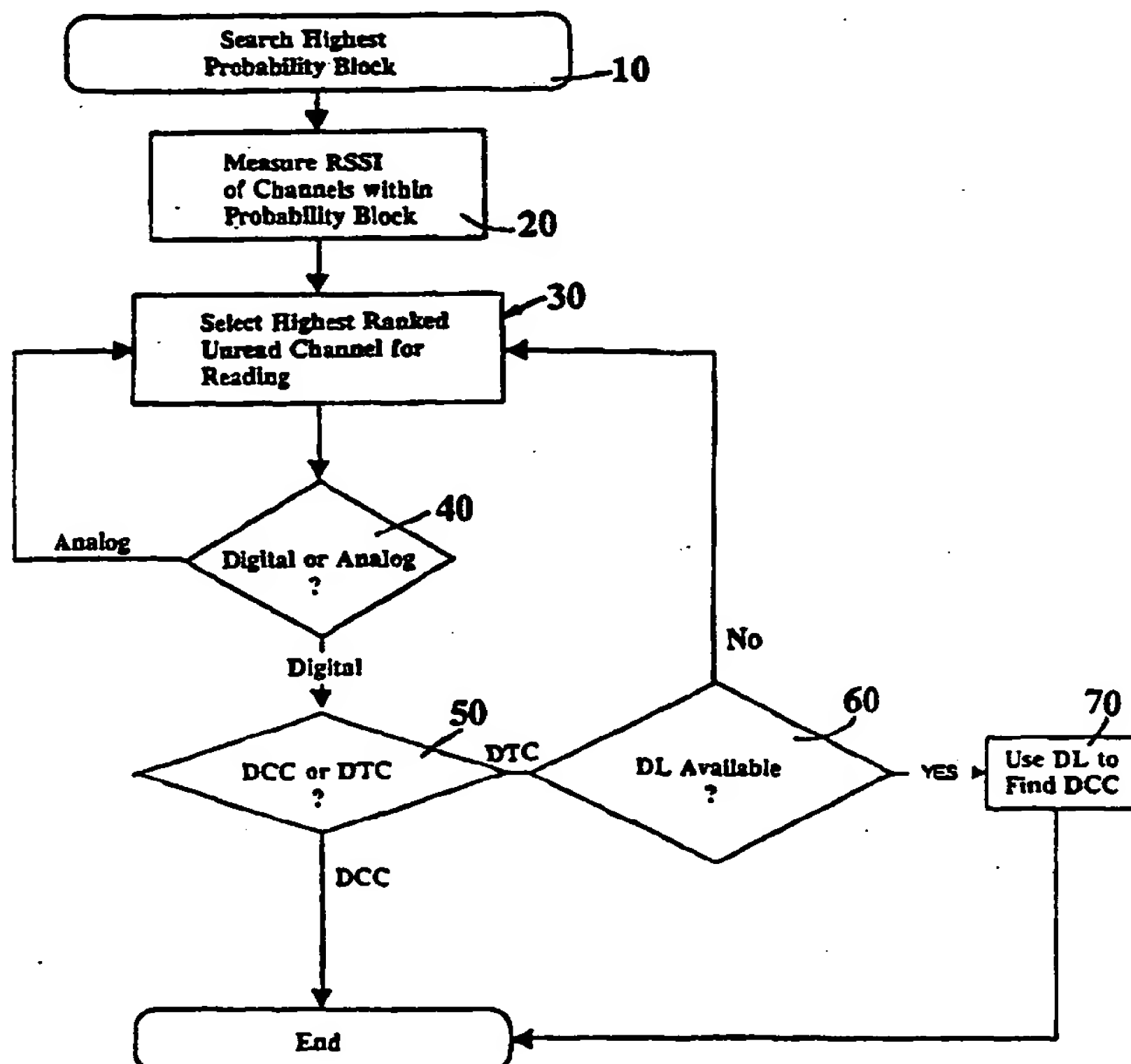
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(54) Title: A METHOD AND APPARATUS FOR LOCATING A DIGITAL CONTROL CHANNEL IN A RADIOCOMMUNICATION SYSTEM

## (57) Abstract

A method and system for locating control channels (70), particularly digital control channels are described. By grouping the channels which are candidates for carrying supervisory messages in blocks indicative of their relative likelihood for being used as control channels, a mobile station can begin its search for a control channel with channels which are most likely to actually be control channels. Placing location information on other channels allows the mobile station (120) to be redirected to a control channel when it reads one of these other channels. Similarly, by placing information describing the location of a control channel in a message associated with handoff, a mobile station avoids the necessity of having to relocate a new control channel associated with the base station to which the mobile has been handed off.



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## A METHOD AND APPARATUS FOR LOCATING A DIGITAL CONTROL CHANNEL IN A RADIOCOMMUNICATION SYSTEM

### RELATED APPLICATION

5       The disclosure of U.S. Patent Application Serial No. 08/147,254 entitled "A Method for Communicating in a Wireless Communication System", filed on November 1, 1993, is incorporated here by reference.

### BACKGROUND

10       The present invention relates generally to radiocommunication systems having control channels and, more particularly, to the location of digital control channels in such systems.

      Radiocommunication systems have traditionally been analog in nature. The rapid growth of radiocommunication systems, however, has compelled system  
15 designers to search for ways in which system capacity can be increased without reducing communication quality beyond consumer tolerance thresholds. One way in which increased capacity can be provided is by changing from analog to digital communication techniques. In North America, this change was implemented by transitioning from the analog AMPS system to a digital system (D-AMPS) which is  
20 now standardized as IS-54B.

      Since a large consumer base having equipment that operated only in the analog domain existed prior to the introduction of digital techniques, a dual-mode (analog and digital) standard was adopted in IS-54B so that analog compatibility was provided in tandem with digital communication capability. For example, the IS-54B standard  
25 provides for both analog and digital traffic channels, wherein the system operator can replace analog traffic channels with digital traffic channels, and vice-versa, in a dynamic manner to accommodate fluctuating traffic patterns among analog and digital users.

      In addition to traffic channels, radiocommunication systems also provide control  
30 channels which are used to carry call setup data messages between base stations and mobile stations. According to IS-54B, for example, there are 21 dedicated analog control channels which are assigned to fixed frequencies for each of the A and B

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carriers. These analog control channels are termed "dedicated" since they are always found at the same frequency and, therefore, can be readily located by the mobile stations which need to monitor the data which is transmitted thereon.

For example, when in the idle state (i.e., turned on but not in use), a mobile station in an IS-54B system tunes to and then continuously monitors the strongest control channel at its known frequency (generally, the control channel of the cell in which the mobile station is located at that moment) and may receive or initiate a telephone call through the corresponding base station. When moving between cells while in the idle state, the mobile station will eventually "lose" radio connection on the control channel of the "old" cell and tune to the control channel of the "new" cell. The initial tuning to, and the change of, control channel are both accomplished automatically by scanning all the control channels at their known frequencies in operation in the cellular system to find the "best" control channel. When a control channel with good reception quality is found, the mobile station remains tuned to this channel until the quality deteriorates again. In this manner, all mobile stations are nearly always "in touch" with the system.

As such hybrid systems mature, it is anticipated that the number of analog users will diminish and the number of digital users will increase. Eventually all of the analog traffic channels will probably be replaced by digital traffic channels. When that occurs, less expensive digital-only mobile units can replace the current dual-mode units. However, such digital-only mobile units would be unable to scan the analog control channels currently provided in the IS-54B system.

Accordingly, it is desirable to provide digital control channels to radiocommunication systems which support digital technology, such as that described by IS-54B. In addition to compatibility issues, digital control channels are also desirable for other reasons described in the above-identified application, for example an enhanced sleep mode for mobile units which results in longer battery life. Whereas IS-54B provides dedicated control channels, more flexibility is desirable in assigning the number of control channels and the frequencies for these control channels to optimize system capacity and to support hierarchical cell structures, i.e., microcells, picocells, etc. If, however, the digital control channels are not located on known frequencies,

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the question arises as to how the remote units will be able to locate these control channels for monitoring.

One conventional radiocommunication system used in Europe, known as the GSM, is already an all-digital system. In this system, the mobile unit simply scans  
5 through all of the available channels until it identifies a digital control channel. This location technique, however, is too slow for systems having a large number of channels. Moreover, the problem of locating a digital control channel after call termination is exacerbated by handoffs of mobile units that move from cell to cell, since a mobile unit cannot then even use its knowledge of the location of the control  
10 channel which it had been monitoring prior to the call.

### SUMMARY

These and other drawbacks and limitations of conventional systems and methods are overcome according to the present invention wherein digital control channel  
15 location is expedited by, for example, prescribing a search pattern based on a relative likelihood of finding a digital control channel on a particular channel or group of channels and providing digital control channel location information on other channels.

According to exemplary embodiments of the present invention, channels are grouped into probability blocks which are ranked in accordance with the relative  
20 likelihood of finding the digital control channel in each block. A mobile unit can then look for a digital control channel within a highest ranked probability block, followed by a second highest ranked probability block and so on, until a digital control channel is located.

According to other exemplary embodiments of the present invention,  
25 information can be provided on other channels, such as traffic channels or analog control channels, which points the mobile station to a particular channel on which a digital control channel can be found or a group of channels within which a digital control channel can be found. In this way, the location process is expedited when compared with sequential channel searching.

30 According to still further exemplary embodiments of the present invention, a mobile unit can receive information about digital control channel location during call termination. In this way, the mobile unit need not repeat the process of trying to

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determine where a digital control channel is located immediately after call termination, which is particularly useful in situations where the mobile moved to a new cell during the call.

5

### **BRIEF DESCRIPTION OF THE DRAWINGS**

The foregoing, and other, objects, features and advantages of the present invention will be more readily understood upon reading the following detailed description in conjunction with the drawings in which:

Figures 1(a) - 1(d) are tables which show exemplary probability block schemes  
10 according to the present invention;

Figure 2(a) illustrates an exemplary downlink digital traffic channel according to the present invention;

Figure 2(b) illustrates a conventional uplink digital traffic channel;

Figure 2(c) illustrates an exemplary uplink digital control channel slot format  
15 according to the present invention;

Figure 2(d) illustrates an exemplary downlink digital control channel slot format according to the present invention;

Figure 3 is a flow chart which depicts an exemplary method for locating a digital control channel according to the present invention;

Figure 4(a) is a table which illustrates an exemplary message format according  
20 to the present invention;

Figure 4(b) is a table which illustrates an entry of the table of Figure 4(a) in more detail; and

Figure 5 is a block diagram of an exemplary radio communication system  
25 according to the present invention.

### **DETAILED DESCRIPTION**

According to exemplary embodiments of the present invention, several techniques can be used, either together or individually, to expedite the acquisition of a  
30 digital control channel by the mobile station.

One technique which can be used to aid the mobile in searching for a digital control channel is to group the available frequencies into blocks which are assigned



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different probabilities that reflect the relative likelihood of finding a digital control channel in each block. In this manner, the time required for service acquisition by the mobile station may be significantly decreased. The two tables depicted in Figure 1(a) and 1(b) are examples of how the channels in the A-Band and B-Band, respectively, can be assigned different relative probabilities for supporting digital control channel acquisition. Similarly, Figures 1(c) and 1(d) present another such example. This technique can be used by a mobile station as a starting point for digital control channel location, for example, before it has received any digital control channel locator information (described below). Once a mobile station has received digital control channel locator information, it can use this information in lieu of the channel block probability scheme described herein.

Another technique for aiding the mobile in its search for a digital control channel is to place digital control channel location information on channels other than the digital control channel so that if the mobile reads such a channel while searching for the DCC, its search can be expedited. For example, the digital control channel locator (DL) is a parameter which can be placed on the digital traffic channel and that provides information to assist a mobile station in finding a digital control channel. The DL identifies for the mobile station the RF channel which carries a digital control channel. Depending upon the number of bits available to express the DL and the number of channels in the system, the DL may uniquely identify the channel on which a digital control channel resides or it may narrow the search to some subset of the possible channels. For example, if a 7-bit DL is provided, then DL values 1, 2, 3...127 would be mapped to channel numbers 1-8, 9-16, 17-24,...1009-1016, respectively. Thus, for example, if a digital control channel occupies channel number 10, then a DL value of 2 would be sent on the digital traffic channels in the same cell. The DL value of zero does not provide any digital control channel location information, but instead indicates that no DL information is being provided by the system.

Once DL values are determined, they are encoded to form the CDL which is sent on the digital traffic channel in, for example, bit positions 314 to 324 in a TDMA slot. This is illustrated by the exemplary digital traffic channel base-to-mobile slot format shown in Figure 2(a). The numbers below the data fields indicate the number

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of bits therein. Fields other than the CDL are those found in conventional IS-54B base-to-mobile traffic channel slots and the interested reader is referred thereto for additional information. Exemplary uplink digital traffic channel, uplink digital control channel, and downlink digital control channel slot formats are illustrated as Figures 2(b), 2(c) and 2(d), respectively, for reference and later discussion. Those skilled in the art will appreciate that other bit positions can be used for the CDL field in the slot, however, this particular position is advantageous in that it corresponds to the previously unused RSVD field of the downlink digital traffic channel slots of IS-54B. In this way, changes to the IS-54B air interface are minimized. These RSVD bits are defaulted to zeros in the IS-54B specification, which conveniently indicates when no location information has been provided. Another possibility would be to provide the DL into the Layer 2 frame of the DTC.

According to exemplary embodiments of the present invention, all channel numbers are valid candidates for digital control channel assignment. Considering that the DL does not necessarily uniquely identify any particular channel number, it is desirable that a priority scheme be established which can be used to search for digital control channel within each channel block identified by the DL. A mobile station receiving the DL value associated with a particular channel block will not automatically search all channels, but will instead search for a digital control channel in this block in accordance with this priority scheme. Thus, for example, for a DL value of 1, a mobile station could examine channel numbers 8 through 1 starting with channel 8 then 7, etc., in an attempt to find the digital control channel.

Having described exemplary techniques which can be used to expedite the location of a digital control channel, other exemplary embodiments of the present invention will now be described wherein these techniques are applied in various situations. For example, and with reference to the flow chart of Figure 3, suppose that a mobile station is seeking a digital control channel on the A-Band carrier of an IS-54 system. As shown at block 10, the mobile will first examine, assuming that no other information is available in the mobile station, the channels within the highest ranked probability block, for example, block 1 having channel numbers 1-26 in Figure 1(a). Within this block of channels, the mobile will select a first channel to read based on some predetermined criteria. For example, as described in block 20, this criteria can



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be the measured signal strength of the channels within the probability block. Alternately, the channels could be read in numbered order within the block. Thus, the mobile measures the signal strength (RSSI) of channels 1-26 and ranks them in order from strongest to weakest. The highest signal strength channel, denoted channel 'X' for this discussion, is then selected for reading at block 30. If this selected channel 'X' is identified as an analog channel at block 40, i.e., either an analog control channel or an analog traffic channel, then the flow returns to block 30 where the next highest ranked channel is selected for reading. If, on the other hand, channel 'X' is a digital channel, then the flow proceeds to decision block 50 wherein the digital channel is identified as being either a control channel or a traffic channel. This identification can be performed in a variety of ways.

As an example for distinguishing between a digital traffic channel and a digital control channel, the IS-54 standard will again be used as an illustrative reference. Although the IS-54B digital traffic channel and digital control channel downlink slot format have structural commonality, as seen in Figures 2(a) and 2(c), there are also certain differences which allow for distinguishing a digital control channel from a digital traffic channel. First, because of the differences in the channel coding of the digital verification color code (DVCC) and superframe (SFP) fields, there are always 4 bits out of 12 which are different in every pair of CDVCC and CSFP codewords regardless of which CDVCC or CSFP codeword is transmitted by a base station (bit errors introduced due to radio channel impairments, however, may change the extent to which transmitted codewords differ once they are received by a mobile station). More specifically, the four check bits of the CSFP are inverted relative to the check bits of the CDVCC. Secondly, the CDVCC content is fixed from slot to slot on a digital traffic channel whereas the content of the CSFP changes in a predictable fashion from slot to slot on a digital control channel.

Another distinction which could be used is that the channel coding and interleaving employed on a digital traffic channel is different from that employed on a digital control channel regardless of the DTC service (speech or FACCH). For example, the digital traffic channel might use 1/2 rate coding while the digital control channel uses 1/4 rate coding. Moreover, the IS-54B SACCH and RESERVED fields have different functionality on a digital control channel. The actual function of each of

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the fields illustrated in Figures 2(a) - 2(d) is not germane to the present discussion, however, for a more detailed explanation of the functionality of these fields reference is made to the above-incorporated application.

If channel 'X' is a digital control channel then the location process has  
5 accomplished its goal and the flow proceeds to the END block. If, on the other hand, channel 'X' is a digital traffic channel, then the process moves to block 60 wherein it is determined whether or not the digital traffic channel includes digital control channel location information, such as the aforescribed DL field. If not, then the mobile reads another channel and the flow moves back to block 30. If so, then this  
10 information is used to find the digital control channel at block 70.

As an alternative to the foregoing probability block scheme, in hybrid systems where analog control channels still exist, such as the IS-54B, digital location information can be placed on these channels. For example, digital control channel information can be placed on each of the 21 dedicated analog control channels found  
15 on both carriers in IS-54B. Then, a mobile station can first tune to the strongest available analog control channel, determine where the digital control channel for that cell is located, and then tune directly to the digital control channel.

According to another exemplary embodiment of the present invention, information regarding digital control channel location can also be provided to a mobile  
20 station when that mobile station undergoes a call termination. One of the messages which is typically sent from a base station to a mobile station in connection with the termination of a call is a RELEASE message which informs the mobile search for a DCC on an indicated frequency. By placing information regarding the location of a digital control channel associated with the cell in which the mobile station is located at  
25 the time of call termination on the RELEASE message, the mobile station need not then go through any procedures for locating a new digital control channel. In this way, the mobile station will have knowledge of digital control channel location regardless of whether it has been handed off or not during a previous connection.

As an example, Figures 4(a) and 4(b) illustrate message formats by which  
30 information can be provided to a mobile station in the RELEASE message for finding a digital control channel. Figure 4(a) shows an overview of an exemplary RELEASE message format which includes a Type O (optional) DCC information field having 29

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bits. An exemplary format for these 29 bits is illustrated in Figure 4(b). Therein, the "Parameter Type" field identifies the field as a DCC information field. The "Number of Values" field indicates how many information elements are in the message. The "Channel" field identifies the frequency on which a control channel can be found and the "DVCC field" provides digital verification color code information. Of course those skilled in the art will appreciate that the foregoing signal format is only an exemplary, illustrative manner in which digital control channel location information can be provided and that other formats can be used.

Figure 5 represents a block diagram of an exemplary cellular mobile radiotelephone system according to one embodiment of the present invention which can be used to implement the foregoing. The system shows an exemplary base station 110 and a mobile 120. The base station includes a control and processing unit 130 which is connected to the MSC 140 which in turn is connected to the public switched telephone network (not shown).

The base station 110 for a cell includes a plurality of voice channels handled by voice channel transceiver 150 which is controlled by the control and processing unit 130. Also, each base station includes a control channel transceiver 160 which may be capable of handling more than one control channel. The control channel transceiver 160 is controlled by the control and processing unit 130. The control channel transceiver 160 broadcasts control information over the control channel of the base station or cell to mobiles locked to that control channel. The voice channel transceiver handles the traffic or voice channels which can include digital control channel location information as described previously.

When the mobile 120 first enters the idle mode, it periodically scans the control channels of base stations like base station 110 to determine which cell to lock on or camp to. The mobile 120 receives the absolute and relative information broadcasted on a control channel at its voice and control channel transceiver 170. Then, the processing unit 180 evaluates the received control channel information which includes the characteristics of the candidate cells and determines which cell the mobile should lock to. The received control channel information not only includes absolute information concerning the cell with which it is associated, but also contains relative information concerning other cells proximate to the cell with which the control channel

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is associated. These adjacent cells are periodically scanned while monitoring the primary control channel to determine if there is a more suitable candidate. Additional information relating to specifics of mobile and base station implementations can be found in copending U.S. Patent Application Serial No. 07/967,027 entitled "Multi-  
5 Mode Signal Processing" filed on October 27, 1992 to P. Dent and B. Ekelund, which disclosure is incorporated here by reference.

The above-described exemplary embodiments are intended to be illustrative in all respects, rather than restrictive, of the present invention. Although the foregoing exemplary embodiments have been described in terms of base and mobile stations, the  
10 present invention can be applied to any radiocommunication system. For example, satellites could transmit and receive data in communication with remote devices, including portable units, PCS devices, personal digital assistants, etc.

Thus the present invention is capable of many variations in detailed implementation that can be derived from the description contained herein by a person  
15 skilled in the art. All such variations and modifications are considered to be within the scope and spirit of the present invention as defined by the following claims.

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**WHAT IS CLAIMED IS:**

- 5           1.       A method for locating a control channel among a plurality of channels comprising the steps of:
- broadcasting, on a plurality of said channels, location information which points toward said control channel;
- reading, by a mobile station, one of said plurality of channels to acquire
- 10   said location information; and
- locating, by said mobile station, said control channel using said location information.
2.       The method of claim 1, wherein said plurality of channels comprise
- 15   digital traffic channels.
3.       The method of claim 1, wherein said plurality of channels comprise analog traffic channels.
- 20           4.       The method of claim 1, wherein said plurality of channels comprise analog control channels.
5.       A system for locating a control channel among a plurality of channels comprising:
- 25                      a base station which broadcasts said plurality of channels and includes location information on at least some of said channels, said location information pointing toward a control channel; and
- a mobile station which reads one of said at least some of said channels to acquire said location information and which then locates said control channel using said
- 30   location information.
6.       The system of claim 5, wherein said at least some of said channels comprise digital traffic channels.

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7. The system of claim 5, wherein said at least some of said channels  
comprise analog traffic channels.

8. The system of claim 5, wherein said at least some of said channels  
5 comprise analog control channels.

9. A base station comprising:  
means for broadcasting control channels and traffic channels; and  
means for including location information on at least some of said control  
10 and traffic channels, said location information pointing toward at least one of said  
control channels.

10. The base station of claim 9, wherein said at least some of said control  
and traffic channels comprise digital traffic channels.

15

11. The base station of claim 9, wherein said at least some of said control  
and traffic channels comprise analog traffic channels.

12. The base station of claim 9, wherein said at least some of said control  
20 and traffic channels comprise analog control channels.

13. A method for broadcasting from a base station on channels comprising  
the steps of:  
25 providing location information pointing to a digital control channel on at  
least some of said channels; and  
broadcasting said channels over an air interface.

14. The method of claim 13, wherein said at least some of said channels  
30 comprise digital traffic channels.



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15. The method of claim 13, wherein said at least some of said channels  
comprise analog traffic channels.

16. The method of claim 13, wherein said at least some of said channels  
5 comprise analog control channels.

17. A mobile station comprising:  
means for reading location information pointing to a digital control  
channel from channels which are broadcast over an air interface; and  
10 means for tuning to said digital control channel using said location  
information.

18. The mobile station of claim 17, wherein said channels comprise digital  
traffic channels.  
15

19. The mobile station of claim 17, wherein said channels comprise analog  
traffic channels.

20. The mobile station of claim 17, wherein said channels comprise analog  
20 control channels.

21. A method for monitoring a digital control channel among a plurality of  
channels using a mobile station comprising the steps of:  
reading one of said plurality of channels;  
25 acquiring location information pointing to said digital control channel  
from said one of said plurality of channels; and  
monitoring said digital control channel using said location information.

22. The method of claim 21, wherein said one of said plurality of channels  
30 comprises a digital traffic channel.

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23. The method of claim 21, wherein said one of said plurality of channels comprises an analog traffic channel.

24. The method of claim 21, wherein said one of said plurality of channels  
5 comprises an analog control channel.

25. A method for locating a control channel in a radiocommunication system comprising the steps of:

providing a connection between a mobile station and a base station in  
10 said radiocommunication system;

sending a message, at the termination of said connection, from said base station to said mobile station which includes location information pointing to said control channel; and

tuning to said control channel, at said mobile station, using said location  
15 information received from said base station.

26. A radiocommunication system comprising:

a plurality of control channels over which base stations transmit and receive supervisory data;

20 a plurality of traffic channels over which base stations transmit and receive traffic data;

at least one mobile station which is connected to one of said base stations using one of said plurality of traffic channels; and

means, in said one of said base stations, for transmitting a message to  
25 said at least one mobile station when said at least one mobile station is disconnecting from said one of said base stations, said message including information which points to one of said control channels.

27. A base station comprising:

30 a transceiver for transmitting supervisory data messages on a control channel and traffic messages on a plurality of traffic channels; and

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means for determining information included in said supervisory data messages and said traffic messages, wherein said traffic messages include a field pointing toward said control channel.

5        28.    A method for transmitting a disconnection message from a base station comprising the steps of:

             providing a disconnection message including location information which points to a control channel; and

             transmitting said disconnection message.

10

             29.    A mobile station comprising:

             a receiver for receiving supervisory data messages on any of a plurality of control channels and traffic messages on any of a plurality of traffic channels; and

             a processing unit for extracting location information from a termination  
15    message which indicates a location of one of said plurality of control channels and for commanding said receiver to tune to said one of said plurality of control channels.

             30.    A method for disconnecting a mobile station comprising the steps of:

             receiving a disconnect message over an air interface;

20              acquiring location information from said disconnect message which points to the location of a control channel;

             disconnecting said mobile station; and

             tuning to said control channel using said location information.

25        31.    A method for locating a control channel among a plurality of channels comprising the steps of:

             grouping said plurality of channels into a plurality of blocks;

             ranking each of said blocks based upon a relative likelihood of finding  
said control channel therein; and

30              investigating channels within a highest ranked block to locate a control channel.

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32. A radiocommunication system comprising:  
a base station which communicates with mobile stations using a plurality of channels, said channels grouped into a plurality of blocks which are ranked based upon a relative likelihood of finding a control channel in each block; and  
5 means, in said mobile stations, for investigating channels in said blocks based upon said ranking.

33. A method for locating a digital control channel in a radiocommunication system having a plurality of analog and digital communication channels comprising the  
10 steps of:

grouping said plurality of channels into a plurality of blocks;  
ranking each of said blocks based upon a relative likelihood of finding said digital control channel therein;  
reading a channel within a highest ranked one of said blocks;  
15 determining if said channel is a digital channel;  
continuing, if said channel is not a digital channel, to read and determine channels in said highest ranked one of said blocks until a digital channel is located; and  
identifying, once a digital channel has been located, said digital channel as one of a digital traffic channel and a digital control channel.

20

34. The method of claim 33, further comprising the steps of:  
acquiring, from a read digital traffic channel, location information pointing toward a digital control channel; and  
locating said digital control channel using said information.

25

35. The method of claim 34, wherein said location information comprises a field which identifies a subset of said plurality of analog and digital communication channels within which a digital control channel resides.

30

36. A method for locating a digital control channel among a plurality of channels comprising the steps of:  
grouping said plurality of channels into a plurality of blocks;

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ranking each of said blocks based upon a relative likelihood of finding said control channel therein;

reading channels within a highest ranked block to locate a digital channel;

5 obtaining, if said digital channel is a digital traffic channel, location information pointing toward a digital control channel; and

using said location information to locate said digital control channel.

37. The method of claim 1, wherein said step of broadcasting further  
10 comprises the step of:

providing, as said location information, a parameter which points to a subset of said plurality of channels.

38. The method of claim 37, further comprising the step of:  
15 ordering channels within said subset of said plurality of channels.

39. The method of claim 38, wherein said step of reading further comprises the step of:  
prioritizing a selection of said one of said plurality of channels based  
20 upon said step of ordering.

40. The method of claim 1, wherein said step of broadcasting further comprises the step of:  
providing a frequency on which said control channel can be found.  
25

41. The system of claim 5, wherein said base station broadcasts, as said location information, a parameter which points to a subset of said plurality of channels.

42. The system of claim 41, wherein said base station orders channels within  
30 said subset of said plurality of channels.

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43. The system of claim 42, wherein said mobile station orioritizes reading of said subset of channels based upon an order created by said base station.

44. The system of claim 5, wherein said base station broadcasts, as said  
5 location information, a frequency on which said control channel can be found.

45. The base station of claim 9, wherein said location information includes a parameter which points to a subset of said channels.

10 46. The base station of claim 45, wherein said base station further comprises:  
means for ordering channels within said subset.

47. The base station of claim 9, wherein said location information includes a  
15 frequency on which said at least one of said control channels can be found.

48. The method of claim 13, wherein said location information includes a parameter which points to a subset of said channels.

20 49. The method of claim 13, further comprising the step of:  
ordering channels within said subset.

50. The method of claim 13, wherein said location information includes a  
frequency on which said digital control channel can be found.

25 51. The mobile station of claim 17, wherein said location information includes a parameter which points to a subset of said channels.

52. The mobile station of claim 51, wherein said mobile station further  
30 comprises:  
means for prioritizing a search for said digital control channel based upon a predetermined order of channels within said subset.



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53. The mobile station of claim 17, wherein said location information includes a frequency on which said digital control channel can be found.

54. The method of claim 21, wherein said location information includes a  
5 parameter which points to a subset of said channels.

55. The method of claim 54, further comprising the step of:  
prioritizing a search for said digital control channel based upon a  
predetermined order of channels within said subset.  
10

56. The method of claim 21, wherein said location information includes a frequency on which said digital control channel can be found.

57. A method for distinguishing between a digital traffic channel and a  
15 digital control channel comprising the steps of:  
identifying a field in a time slot of a channel which is either a CDVCC  
field or a CSFP field, depending upon whether said channel is a digital traffic channel  
or a digital control channel, respectively;  
determining whether said field has check bits which are inverted relative  
20 to check bits of a digital traffic channel;  
characterizing said channel as a digital control channel if said check bits  
are inverted, otherwise characterizing said channel as a digital traffic channel.

58. A method for broadcasting digital traffic channels and digital control  
25 channels comprising the steps of:  
broadcasting, from a base station, digital traffic channels including  
CDVCC fields and digital control channels including CSFP fields;  
including, in said CDVCC fields, first check bits;  
providing, in said CSFP fields, second check bits; and  
30 wherein said first and second check bits are inverted relative to one  
another.

- 20 -

59. A method for distinguishing between a digital traffic channel and a digital control channel in a mobile station comprising the steps of:

receiving and decoding a field in a channel which has been broadcast over an air interface;

5

determining if error correction bits in said field are inverted relative to a predetermined set of error correction bits; and

identifying said channel as a digital traffic channel or as a digital control channel based upon said step of determining.

10

60. A base station comprising:

a transmitter for broadcasting digital traffic channels and digital control channels;

15 a processor for including CDVCC fields in said digital traffic channels and CSFP fields in said digital control channels;

said processor also including, in said CDVCC fields, first check bits;

said processor also providing, in said CSFP fields, second check bits;

and

20 wherein said first and second check bits are inverted relative to one another.

61. A mobile station comprising:

means for receiving and decoding a field in a channel which has been broadcast over an air interface;

25 a processor for determining if error correction bits in said field are inverted relative to a predetermined set of error correction bits; and

wherein said processor identifies said channel as a digital traffic channel or as a digital control channel based upon said determination.

30

62. A base station comprising:

a transmitter for broadcasting a digital traffic channel and a digital control channel using timeslots;

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a processor for including a CDVCC field in said digital traffic channel and a CSFP field in said digital control channel; and

wherein a value of said CDVCC fields remains fixed from timeslot to timeslot while a value of said CSFP fields varies from timeslot to timeslot.

5

63. A mobile station comprising:

means for receiving and decoding a field over a plurality of timeslots in a channel which has been broadcast over an air interface; and

a processor for determining whether a value of said field varies from  
10 timeslot to timeslot.

64. A base station comprising:

an encoder for encoding digital traffic channels at a first rate and digital control channels at a second rate; and

15 a transmitter for broadcasting said digital traffic channels and digital control channels.

65. A mobile station comprising:

20 means for receiving a channel broadcast over an air interface;  
means for decoding a received signal and determining a rate at which said received signal was encoded; and

a processor for identifying said channel as a control channel if said rate is a first rate and for identifying said channel as a traffic channel if said rate is a second rate.

25

66. The mobile station of claim 65, wherein said first rate is 1/4 and said second rate is 1/2.

Channel Numbers	Relative Probability
1-26	1
27-52	2
53-78	3
79-104	4
105-130	5
131-156	6
157-182	7
183-208	8
209-234	9
235-260	10
261-286	11
287-312	12
313-333	16
667-691	13
692-716	14
991-1023	15

FIGURE 1(a)

Channel Numbers	Relative Probability
334-354	16
355-380	1
381-406	2
407-432	3
433-458	4
459-484	5
485-510	6
511-536	7
537-562	8
563-588	9
589-614	10
615-640	11
641-666	12
717-741	13
742-766	14
767-799	15

FIGURE 1(b)

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Block Number	Channel Number	Band	Number of Channels	Relative Probability
1	1 - 26	A	26	4
2	27 - 52	A	26	5
3	53 - 78	A	26	6
4	79 - 104	A	26	7
5	105 - 130	A	26	8
6	131 - 156	A	26	9
7	157 - 182	A	26	10
8	183 - 208	A	26	11
9	209 - 234	A	26	12
10	235 - 260	A	26	13
11	261 - 286	A	26	14
12	287 - 312	A	26	15
13	313 - 333	A	21	16 (Lowest)
14	667 - 691	A	25	3
15	692 - 716	A	25	2
16	991 - 1023	A	33	1 (Highest)

FIGURE 1(c)

Block Number	Channel Number	Band	Number of Channels	Relative Probability
1	334 - 354	B	21	16 (Lowest)
2	355 - 380	B	26	15
3	381 - 406	B	26	14
4	407 - 432	B	26	13
5	433 - 458	B	26	12
6	459 - 484	B	26	11
7	485 - 510	B	26	10
8	511 - 536	B	26	9
9	537 - 562	B	26	8
10	563 - 588	B	26	7
11	589 - 614	B	26	6
12	615 - 640	B	26	5
13	641 - 666	B	26	4
14	717 - 741	B	25	3
15	742 - 766	B	25	2
16	767 - 799	B	33	1 (Highest)

FIGURE 1(d)  
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3/6

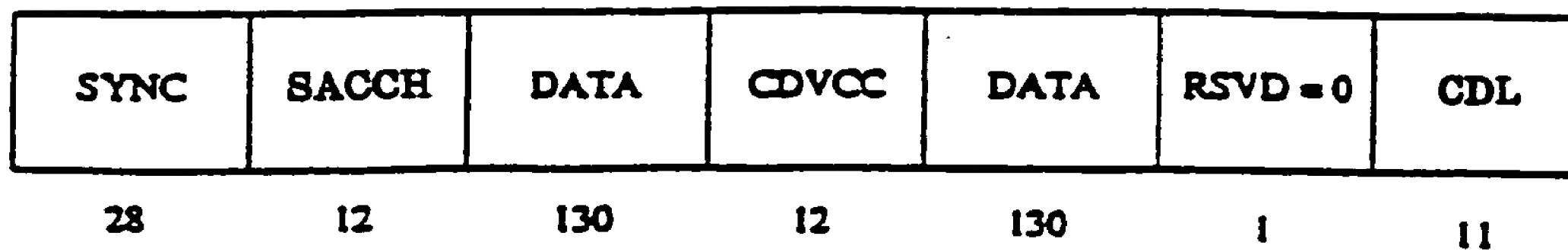


FIGURE 2(a)

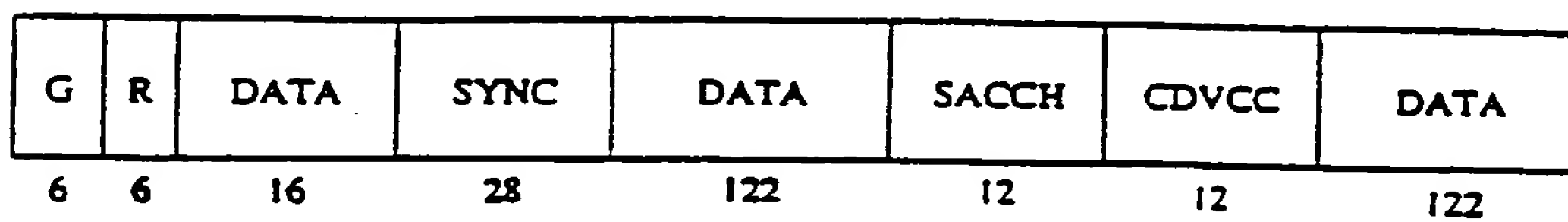


FIGURE 2(b)

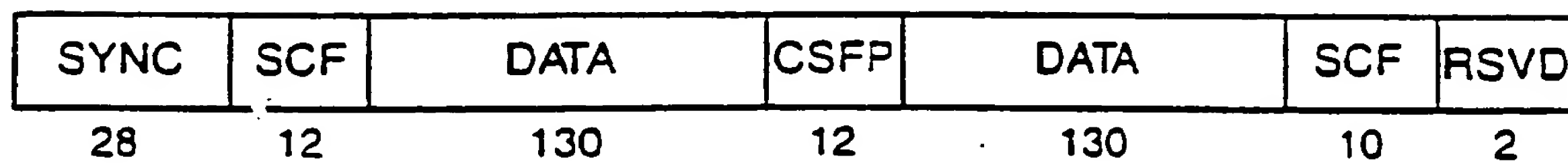


FIGURE 2(c)

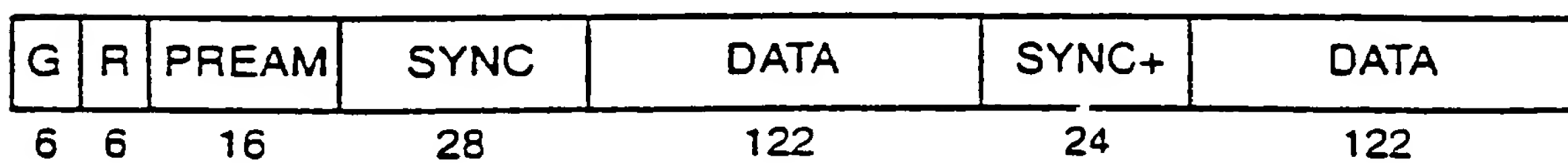


FIGURE 2(d)

SUBSTITUTE SHEET (RULE 26)



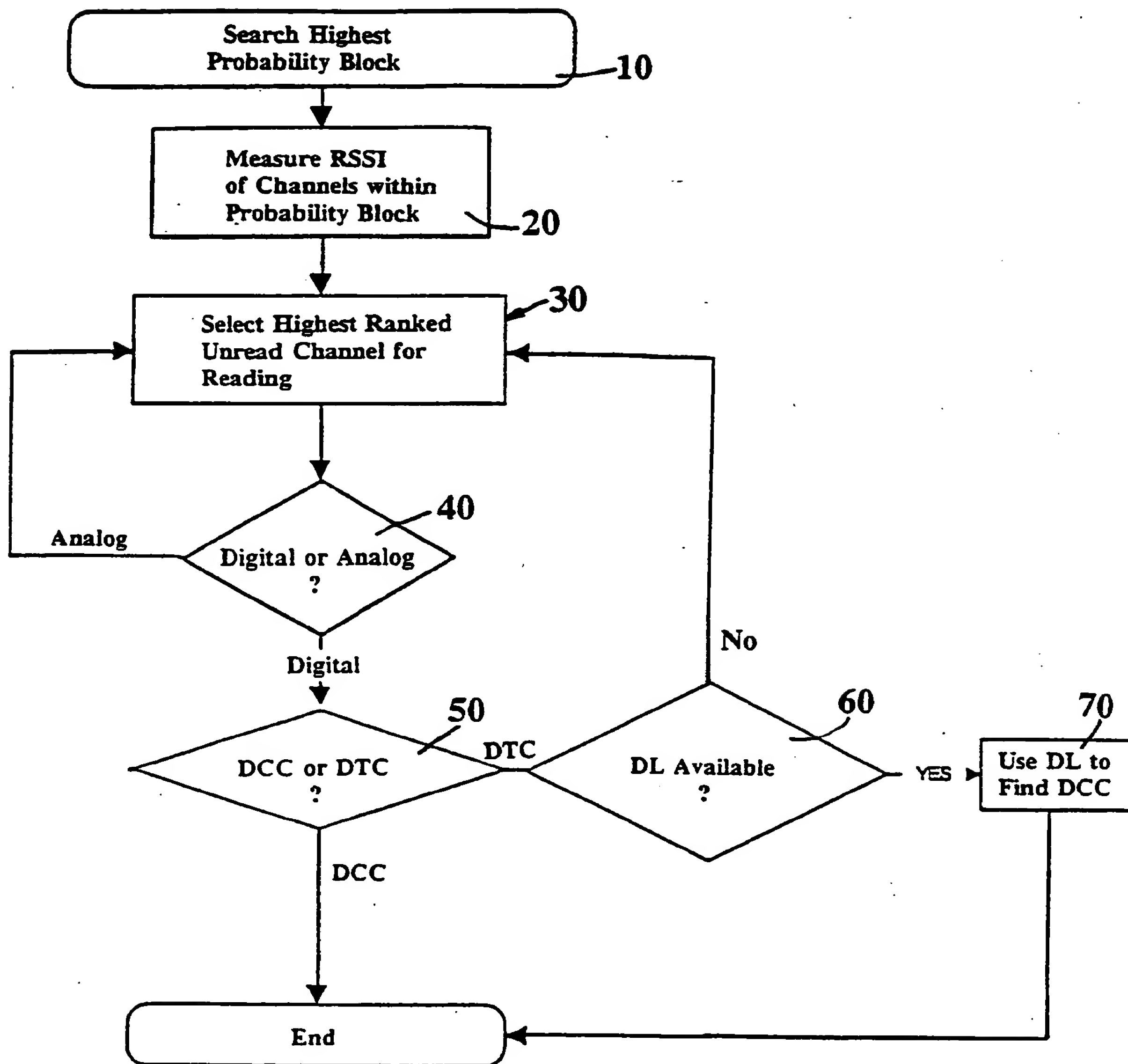


FIGURE 3

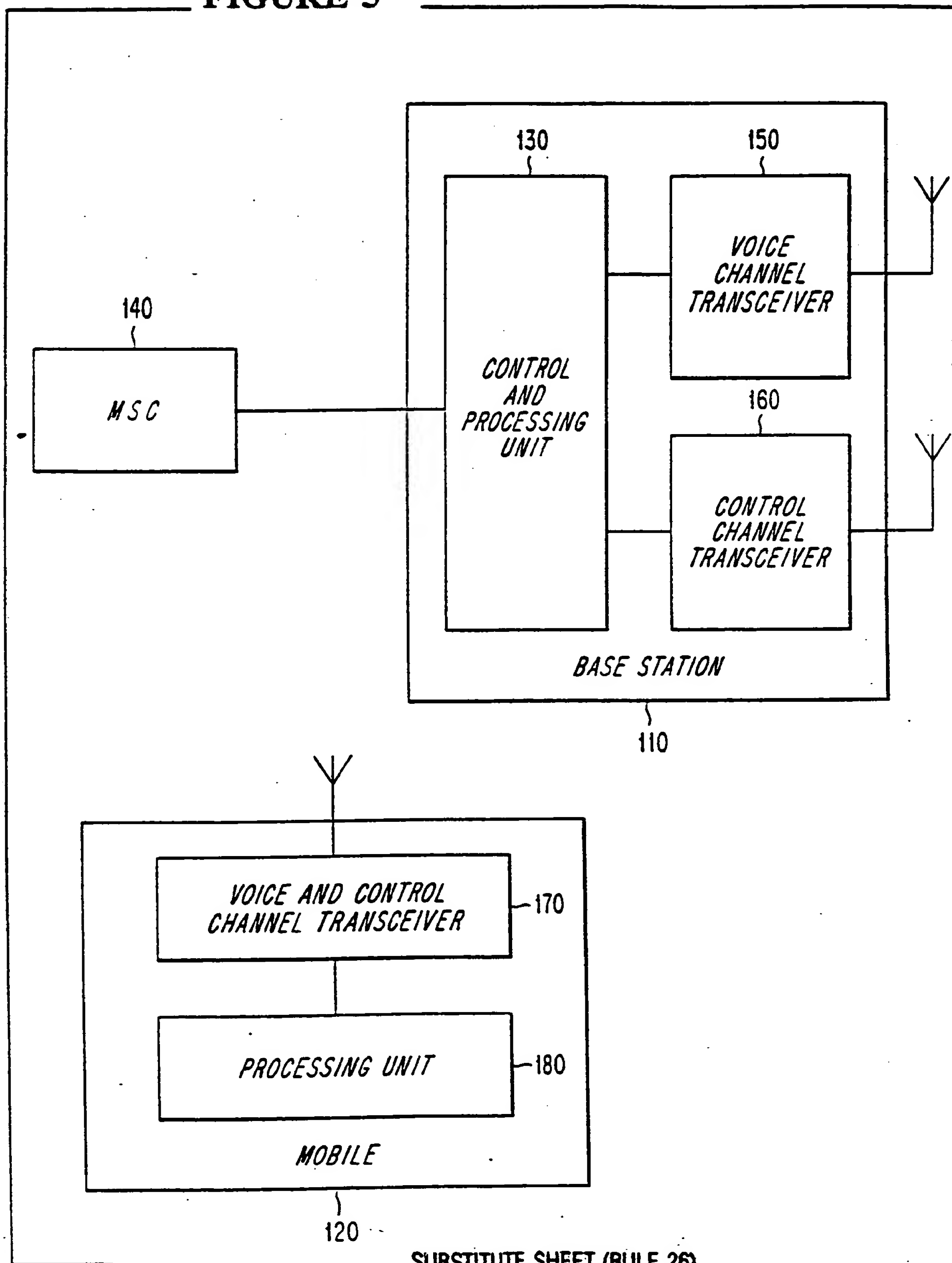
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Information Element	Type	Length (bits)
Protocol Discriminator	M	2
Message Type	M	8
Ack Message Type	M	8
Remaining Length	M	6
Last Decoded Parameter	O	14
DCC Information	O	29

FIGURE 4(a)

Field	Length (bits)
Parameter Type (DCC Information)	4
Number of Values	6
Channel	11
DVCC	8

FIGURE 4(b)

**FIGURE 5**

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US94/12648

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : H04J 3/16; H04M 11/00; H04Q 7/00

US CL : Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/95.1, 95.2, 95.3, 85.7; 455/33.1, 33.2, 33.4, 34.1, 34.2, 54.1, 54.2, 56.1; 379/59, 60

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 4,850,033 (EIZENHOFER ET AL) 18 July 1989, col. 1, lines 34-36, 57-60; col. 3, lines 2-5, 29-34; col. 4, lines 26-42; col. 5, 15-33.	1,5,9,13,17,21 ,63,64 ----- 2-4, 6-8, 10- 12,14-16, 18- 20,22- 24,37-56
Y	US, A, 5,200,957 (DAHLIN) 06 April 1993, Fig. 4.	12,14-16, 18-20,22- 24,37-56
A	US, A, 5,257,401 (DAHLIN ET AL) 26 October 1993, fig.4.	1-66
X,P	US, A, 5,353,332 (RAITH ET AL) 04 October 1994, col.4, lines 32-60.	1-28,37-56

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	* T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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* E earlier document published on or after the international filing date	* Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
* L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	* & document member of the same patent family
* O document referring to an oral disclosure, use, exhibition or other means	
* P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

13 FEBRUARY 1995

Date of mailing of the international search report

13 MAR 1995

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US94/12648

## A. CLASSIFICATION OF SUBJECT MATTER: US CL :

370/95.1, 95.2, 95.3, 85.7; 455/33.1, 33.2, 33.4, 34.1; 34.2, 54.1, 54.2, 56.1; 379/59, 60